REMARKS

This amendment is in response to the office action of December 9, 2008 in which the Examiner made certain technical objections and rejected the claims over various references discussed below.

The Applicant wishes to thank the Examiner for the opportunity to discuss the application during an interview conducted on March 17, 2009. During the interview Applicant's representative briefly covered the technical objections, which are addressed in detail in this paper. In addition, the substantive objections to the claims based on the art of record were also addressed.

The Examiner's technical objections set forth in paragraphs are discussed below in the order of presentation in the Detailed Action.

With respect to the objection to the word 'being' in claim 1, line 13, applicant believes the word is not awkward, and indeed the word is appropriate. The term 'being' connotes a state or condition. In the claim the term suggests that the opening has a certain area or size relative to the total area or size of the internal surface of the cavity.

With respect to the Examiner's comments regarding the language 'to generate' in claim 1 line 28, the language has been changed to 'for generating'.

In claim 15, spelling of the terms 'internals' and 'areal' has been corrected as suggested by the Examiner.

In paragraph 6 of the Detailed Action, the Examiner made certain objections which are addressed as follows.

The language 'a high efficiency of about 65%' falls within the range 60-70% set forth in [0022] of the application as filed. The claim language has been amended to conform to the language of the specification.

The objection to claim 6 lines 2-3 has been conformed to the specification paragraph [0041] which states that the secondary concentrator has mirrored inner surfaces.

Claims 6-8 have been amended to overcome the Examiner's objection. The terms 'primary' and 'secondary' have been changed to 'parabolic' and 'hyperbolic' respectively, thereby conforming to the language in paragraph [0060].

The specification has been amended to add new paragraph [0042] which incorporates the language of claim 9 into the specification. No new matter has been added because the language of the amendment corresponds the claim language as originally filed.

The language of claim 8 has been amended to correspond to the language of paragraph [0041].

The language of claim 9 has been amended to conform to the specification. However, the terms 'near' and 'good' are believed to be proper terms of art for the properties claimed. These terms mean that the properties are not perfect in all respects but are of a quality that qualifies for them to be characterized in the manner claimed.

Claim 13 has been amended to conform to the claim as filed

Claim 14 has been amended to conform to the claim as filed.

In Claim 25 the terms 'good' and 'near' have not been amended for the reasons set forth above regarding claim 9. The claim has been amended to state that the extractor extends into the cavity.

Claim 30 has been amended to conform to the claim language as filed.

Claims 31-33 have been cancelled.

The objections noted in paragraph 8 of the Detailed Action are addressed below.

Claim 1 has been amended to recite the ratio as up to about 0.01. Claim 10 has been cancelled as the subject matter thereof is included in claim 1.

Claim 5 has been amended to clarify the recitations of the primary concentrator and the secondary concentrator.

Claim 15 has been amended to conform the ratio to claim 1. The rejection of Claims 16-33 as depending from claim 15 is not understood.

The antecedent basis for Cassegrain concentrator has been corrected in claim 17.

Claim 21 has been amended to recite the area of the aperture being up to about 0.01 of the internal area of the sphere.

Claim 26 has been cancelled as the subject matter thereof is incorporated in claim 15.

The Examiner's technical objections to claims 22-25 are believed to have been overcome by the amendments.

The Examiner's rejection of the claims based on the cited art is respectfully traversed for the reasons set forth below.

Claims 1,2,4 and 10-12 are rejected over Ronwin in view of Holloman and D'Amato.

Claims 1 and 15 have been amended in order to recite that the concentrator is external of the cavity or housing and diameter of the laser light or beam is greater than the diameter of the aperture. Claim 15 also recites that the laser light is a reduced to a size smaller than the initial beam diameter and then reduced again in size to a diameter smaller than the diameter of the aperture to thereby concentrate the beam.

Ronwin, allegedly discloses a device in which light is concentrated. Ronwin does not actually teach how this is accomplished, but merely asserts a conclusion, i.e. "converting concentrated light" (see abstract). The concentration alleged by Ronwin is what is known as "integrating sphere multiplier flux concentration" meaning increased radiance within the cavity which in turn means that flux intensity within the cavity has increased. This is a form of concentration which occurs inside of an

integrating sphere over a short interval of time between when the initial photon enters the cavity and is absorbed and when the later admitted photon enters the cavity, just before the initial photon is absorbed. In such a case two photons are present. If yet another photon enters three photons are present. However, much of the energy is absorbed over the interval. The concentration which occurs according to this phenomenon does not normally exceed a concentration of about 30 in the highest quality concentrating spheres, yet for which reflectance is equal to 0.995 and the port fraction is less than 5% of the total area. For the given geometry of Ronwin and the given internal features, the estimated concentration is believed to be less than 3.

Thus, in an integrating sphere the light bounces around and is eventually absorbed or converted to heat. However, during the time the light bounces around until it is absorbed, photons which follow the initial input are also admitted into the integrating sphere, so the light or energy in the sphere reaches an equilibrium, and the resulting concentration is higher than the expected concentration. This increased concentration is still very small compared to the concentration available in the claimed device. In Ronwin, the light so concentrated is directed into the output chamber where it is absorbed by the photoelectric devices and converted to electricity. It should be noted that Ronwin does not further concentrate the light by compressing the energy into a high photon flux stream which is admitted into the output chamber.

The concentration contemplated in the present application is a type known as geometric concentration. This is a form of concentration which occurs when the energy per unit area in the original beam is concentrated so that the energy falling on a given area, less than the area of the original beam, is increased by the geometric concentration ratio or the ratio of the areas. This can occur by collecting energy from a large area and concentrating it on a small area.

For example, in the application, the energy available for conversion is that which is contained in the laser beam. This beam is large and is directed towards a Cassegrain concentrator which includes a parabolic mirror and a hyperbolic mirror. The beam is large, e.g., about the same diameter as the parabolic mirror shown in Fig. 4. The mirror then focuses the energy of the beam onto the hyperbolic mirror which further reduces the diameter of the beam to some given size. If one measures the ratio of the initial laser beam diameter to the further reduced diameter, one can determine the geometric concentration. In this example let the geometric concentration of the Cassegrain may be assumed to be greater than 100.

The beam reduced in diameter by the Cassegrain still contains the same energy as the laser beam (except for reflective losses); it is simply reduced in diameter. The beam which is reduced by 100 times in diameter is then captured in the secondary concentrator (which looks like a funnel in Fig. 1). The secondary concentrator has a large inlet end and a smaller outlet end connected to the aperture. Here too, the concentration is the ratio of the size of the inlet to the size of the outlet. In this example it may roughly be estimated as a ratio of 5. Accordingly, the total concentration of the laser energy is 500, or the product of the concentration ratios of each concentrator.

When the energy is introduced into the sphere, it is subject to the integrating sphere multiplier flux concentration in a way similar to the reference, but, as noted above, the concentration occurs inside the sphere. The concentrator recited in the amended claims is outside the sphere; and the concentration is geometric, i.e. it is based on the ratio of the initial beam diameter to the beam diameter which fits through the aperture.

In Ronwin, the energy is not geometrically concentrated before it enters the chamber. While it may be subject to integrating sphere multiplier flux concentration, the energy which is transferred to the

outlet chamber is still limited by the size of the aperture. In addition, the energy in the chamber is not concentrated in a way that all the energy entering the chamber is geometrically squeezed down or concentrated to the size of the aperture as it is in the claim. In claim 34, the concentration ratio is at least 20.

During the interview, the Examiner indicated that because concentration occurs in the reference, he could interpret that to cover the concentration that occurs in the claim. However, it is submitted that the concentration occurring within the chamber in the reference is of a different type than the claimed concentration occurring outside the chamber.

The Examiner also indicated that concentration occurring in the chamber of the reference is external of the output chamber. However, the concentration is not geometric, because it is limited by the aperture size. In the claim, the aperture does not limit the energy into the chamber.

In the claim the energy admitted into the chamber is that which is contained in the beam which has been reduced in diameter. However, once the energy enters the chamber it is diffused throughout the space, and the probability of escape is measured by the ratio of the aperture size to the area of the chamber. What this means is that once the highly concentrated energy of the beam enters the chamber its escape probability is small.

In the reference, this same phenomenon occurs. However, in the reference, the phenomenon is detrimental to the operation of the device, because the shutter that lets light out of the middle chamber and into the output chamber limits the amount of energy that can be utilized efficiently. In other words, even thought the energy in the middle chamber is "concentrated" due to the integrating sphere phenomenon, and not the geometric phenomenon, the energy still must escape the middle chamber and enter the output chamber. Because the energy in

the middle chamber is not directed in any way, the amount of energy that can get from one chamber to the next is limited by the ratio of the area of the shutter to the area of the middle chamber.

Even if one were to assume that all the energy gets out of the middle chamber and is converted in the output chamber, the concentration ratio due to integrating sphere multiplication would be far less than that which is achieved in the geometric concentration of the invention.

The claims distinguish the invention from the reference by reciting that the diameter of the beam is larger than the diameter of the aperture. This beam is captured by the concentrator and reduced in size so that the energy admitted into the sphere is concentrated. No such concentration occurs in the reference. In addition, even though applicant acknowledges that a different type of concentration occurs in the reference, the utilization of the energy is not effective, because the energy is not able to escape the chamber where it is concentrated to enter the chamber where it is converted by the photoelectric cells.

In this connection, if it is assumed that concentration occurs in the middle chamber, externally of the output chamber, the energy transferred through the shutter is still limited by the ratio of the shutter size to the area of the middle chamber.

It should be noted that Ronwin employs one or more lenses in the fibers connecting the middle chamber and the output chamber. However, this cannot perform a geometric concentration of significance because the lenses are in the output end of the channel, and they cannot increase the amount of energy transferred to the output chamber in any meaningful way. Further, it is not clear how the energy transfer occurs in Ronwin, because the drawings and explanation are not clear. Indeed, it appears that the reference uses inconsistent terminology, and uses a transfer mechanism through a shutter system which inhibits efficient energy transfer.

In a sense, Ronwin is a deconcentrating device because the overall concentration ratio is less than 1. This is because the area of the inlet aperture is smaller than the area over which the energy is dispersed within the cavity, and because there is no concentration of the incoming energy. In the invention, there is likewise a dispersion of the energy within the cavity, but the geometric concentration is much greater than 1 so that the overall concentration is at least 20. In other words, there may be some concentration in the reference due to the integrating sphere multiplier effect, but this is cancelled by the deconcentration occurring within the chamber when the energy is spread over the area of the chamber. Likewise, in the invention, there is a deconcentration effect when the energy is spread out over the area of the chamber, but the overall concentration of the system is much more than the reference, because the geometric concentration is much higher than the reference.

The invention provides for high concentration of energy outside the sphere; then provides for a highly efficient transfer of the energy through a small aperture into the sphere; and also provides for distributing the energy within the sphere so that escape of the energy is suppressed. The reference may indeed exhibit a form of concentration, but it does not utilize the so called concentrated energy so that it can be properly and efficiently converted. Over time, the more energy will be absorbed than will escape through the shutter.

The Examiner asserts that Ronwin does not explicitly disclose the generic light source as being a laser, but that Holloman teaches that a laser can be a source for PV conversion. However, this analysis does not recognize that the size of the laser beam in Holloman is size match the size of the fiber. In Holloman, the beam path is represented by the narrow line emanating from the laser. The source does not fill the parabolic mirror as in the invention. The source is simply directed towards the end of the fiber. There is no geometric concentration.

It is well known that much of the light that falls on the end of a fiber optic is not transmitted down the fiber. It must fall within the numerical aperture or NA of the fiber. The laser beam in the reference is not larger than the aperture available, and even if it is, only the amount of energy limited by the NA can be admitted and transmitted. Therefore it is not obvious to simply direct a large diameter laser power beam at the end of the fiber and think that there will be any significant transmission of power. Only a fraction of the energy in the beam will be carried down the fiber to the PV cell.

D'Amato is not different than Holloman. It simply teaches that laser light can be converted to electrical energy. This reference is for transmission of low power communications signals. D'Amato does not contemplate transmission of power from a large diameter laser power beam.

The relatively large geometric concentration provided by the first and second concentrators of the invention allows the collection of a correspondingly large amount of energy available in a large diameter laser power beam. This is accomplished by reducing the spot size of the beam from the large diameter source size to a small diameter corresponding to the diameter of the aperture. Thus, the relatively large amount of energy contained in the large diameter source beam of the laser can be transmitted through the much smaller aperture of the sphere as high density energy. Thus the energy of the source beam, which enters the sphere is then trapped in the sphere. This happens because the beam is scattered inside the sphere, and the probability of escape of this scattered light is proportional to the size or area of the aperture divided by the total internal area of the sphere.

The prior art cited by the Examiner does not provide for geometric concentration of the beam resulting in a reduction of the beam size to the aperture size. The concentration of provided in the Ronwin reference is a different kind of concentration. Indeed, the sphere of the

present application exhibits a similar form of flux concentration, namely due to the multiplier effect. However, this effect is much smaller than the magnitude of the geometric concentration of the invention; and the invention exhibits a form of concentration which the reference does not exhibit.

In Ronwin, energy must pass through a small shutter, but all the source energy is not available for transmission therethrough. This is because the energy which enters the middle chamber in Ronwin is scattered about. Thus, it is not in a form which can go through the shutter in an amount corresponding to the energy input. This defeats the purpose of transmitting significant power or energy. In other words, the shutter in Ronwin chokes off the energy flow and does not achieve the functional advantage achieved by the invention.

Finally, the claims recite a 'highly collumnated' laser beam. This is important because not all laser beams are the same. Not all are highly columnated. Only highly columnated beams are able to traverse long distances without spreading or dispersing. In other words, if the beam spreads out over long distances, much of the energy will not be captured by the reciever.

In view of the foregoing, it is respectfully requested that the Examiner reconsider his rejection of the claims, the allowance of which is earnestly solicited.

If additional fees are required, the Commissioner is authorized to charge Deposit Account 504147 for such fees or credit any overpayment thereto.

Respectfully submitted,
/John De Luca/
Attorney for Applicant
Reg. No. 25505

CUSTOMER NO: 66804